CERTIFICATE OF VERIFICATION

I, Soo Jin, KIM of 648-23 Yeoksam-dong, Gangnam-gu, Seoul, Republic of Korea state that the attached document is a true and complete translation to the best of my knowledge of the Korean-English language and that the writings contained in the following pages are correct English translation of the specification and claims of the Korean Patent Application No. 10-2003-0001859.

Dated this 15th day of July, 2007.

Signature of translator: S. J. Kim

Soo Jin, KIM

KOREAN INTELLECTUAL PROPERTY OFFICE

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Applicant(s) : LG Electronics Inc.

COMMISIONER

[ABSTRACT OF THE DISCLOSURE]

[ABSTRACT]

The present invention relates to a method for managing a defective area of a write-once type optical disc permitting reading and/or reproducing of data written on a defective area of the recording medium such as BD-WO, properly by writing the data on a spare area in lieu of the defective area and managing the temporary management data, effectively. In addition, the method and apparatus can read and reproduce the data written in other replacement areas when the first replacement area is found to be defective, using status information in a defect entry. The method and apparatus can stop unnecessary defect detecting and/or replacement writing operations if the spare area and the TDFL area are indicated as full based on flag information stored in TDDS information.

[TYPICAL DRAWING]

FIG. 3

[INDEX WORDS]

write-once type Blu-ray Disc (BD-WO), defective area, defect verify unit (DVU), spare area, cluster, defect list (DFL)

[SPECIFICATION]

[TITLE OF THE INVENTION]

METHOD FOR MANAGING DEFECTIVE AREAS OF WRITE-ONCE TYPE OPTICAL DISC

[BRIEF DESCRIPTION OF THE DRAWINGS]

FIG. 1 illustrates a structure of a related art optical disc device schematically.

FIG. 2 illustrates a diagram of a method for managing defective areas of a related art Blu-ray Disc Rewritable (BD-RW).

FIG. 3 illustrates a diagram of a method for managing defective areas of a Blu-ray Disc Write Once (BD-WO) in accordance with a preferred embodiment of the present invention.

FIGS. 4 and 5 illustrate navigation information generated and recorded by a method for managing defective areas of a Blu-ray Disc Write Once (BD-WO) in accordance with the present invention.

FIG. 6 illustrates a disc structure for a Blu-ray Disc Write Once Dual Layer having the present invention applied thereto.

FIG. 7 illustrates a diagram of a method for managing defective areas of a Blu-ray Disc Write Once in accordance with another preferred embodiment of the present invention.

Reference numerals of the essential parts in the drawings

10 : optical disc 11 : optical pickup

12 : VDR system 13 : encoder

[DETAILED DESCRIPTION OF THE INVENTION]

[OBJECT OF THE INVENTION]

[FIELD OF THE INVENTION AND DISCUSSION OF THE RELATED ART]

The present invention relates to a method for managing a defective area of an optical disc of write-once type, such as a Blu-ray Disc Write Once.

Recently, a new type of high density optical disc such as a Blu-ray Disc Rewritable (BD-RW) is expected to be developed. A benefit of the BD-RW is that it has a rewritable capability where the quality video and audio data can be written for long time.

As shown in FIG. 1, an optical disc device for recording/reproducing data to the BD-RW includes: an optical pickup (11) for recording/reproducing a signal to/from an optical disc (10); a VDR (Video Disc Recorder) system for processing a signal from the optical pickup (11) as a reproduced signal, or demodulating and processing an external data stream into a writable signal suitable for writing; and an encoder (13) for encoding an external analog signal and providing the encoded signal to the VDR system.

Referring to FIG. 2, the BD-RW is divided into a Lead-

In Area (LIA), data area, and a Lead-Out area (LOA), with an Inner Spare Area (ISA) and an Outer Spare Area (OSA) assigned to a fore end and a rear end of the data area.

The VDR system (12) of the optical disc device writes in the data area in clusters corresponding to an ECC block unit having a predetermined size of recording, after the VDR system (12) encodes and demodulates the external signal into a signal suitable for writing. As shown in FIG. 2, during the writing process, if there is a defective area found in the data area, the VDR system (12) carries out a series of replacement writing operations in which the clusters of data written onto the defective area is written onto one of the spare areas, e.g., on the ISA in place of the defective area.

Therefore, even if there is a defective area in the data area of the BD-RE, the VDR system (12) can prevent a data writing error in advance by writing the clusters of data written in the defective area onto the spare area.

Unfortunately, since the BD-WO is still in the early development stage, there are no schemes, no disc structures, no apparatuses and no methods on how to manage the defective areas of the BD-WO, which will be needed for the BD-WO to be commercially viable and operationally feasible.

[TECHNICAL TASKS TO BE ACHIEVED BY THE INVENTION]

Accordingly, the present invention is directed to a method for managing a defective area of an optical disc that substantially obviates one or more problems due to limitations and disadvantages of the related art.

An object of the present invention is to provide a method for managing a defective area of an optical disc for carrying out a series of replacement writing operations in which data written onto the defective area of an optical disc such as a Blu-ray Disc write-Once (BD-WO) is written onto other data areas or spare areas efficiently.

[SYSTEM AND OPERATION OF THE INVENTION]

To achieve these and other advantages and in accordance with the purpose of the present invention, as embodied and broadly described, a method for managing a defective area on an optical disc of writable once type includes: a first step of writing data at a predetermined area and detecting an existence of a defective area within the recording area; a second step of writing data recorded in the defective area onto the spare area allocated in the data area; a third step of writing navigation information for the defective area onto a specified area allocated in the data area; and a fourth step of writing information for accessing the navigation information written on the specified area onto a reserved area in the Lead-In Area.

A method for managing a defective area on an optical disc of writable once type according to the present invention includes: a first step of writing data recorded in the defective area onto the spare area allocated in the data area; and a second step of writing navigation information for the defective area onto a specified area allocated in the data area, and the location information stored data for the last is stored in the navigation information together with identification information for identifying the fact if the defect is detected from data stored in the spare area and stored into another space of the spare area.

A method for managing a defective area on an optical disc of writable once type according to the present invention includes: a first step of detecting whether or not a spare area or a specified area assigned to the data area are full with data when recording and reproducing data; and a second step of stopping detecting defective area and recording replacement operations if the spare area or the specified area are full with data.

A method for managing a defective area on an optical disc of writable once type includes: a first step of writing data at a predetermined area and detecting an existence of a defective area within the recording area; a second step of writing data recorded in the defective area onto the spare area allocated in the data area; a third step of writing

navigation information for the defective area onto a specified area allocated in the data area; and a fourth step of writing information for accessing the navigation information written on the specified area.

A method for managing a defective area on an optical disc of writable once type according to the present invention includes: a first step of writing data recorded in the defective area onto the spare area allocated in the data area; and a second step of writing navigation information for the defective area onto a specified area allocated in prior to the data area, and the location information stored data for the last is stored in the navigation information together with identification information for identifying the fact if the defect is detected from data stored in the spare area and stored into another space of the spare area.

In an optical disc of writable once type in which lead-in area and data area are assigned, an optical disc of writable once type assigning a spare area for writing data of defective area in the data area, and the navigation information of the defective area is stored in prior to the data area as a temporary defect list.

In an optical disc of writable once type in which lead-in area and data area are assigned, an optical disc of writable once type assigning a spare area for writing data of defective area in the data area, and the navigation

information of the defective area is stored in the data area as a temporary defect list.

Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrates in the accompanying drawings.

FIG. 3 illustrates a diagram of a method for managing defective areas of a Blu-ray Disc Write Once (BD-WO) in accordance with a preferred embodiment of the present invention. Referring to FIG. 3, for example, the BD-WO includes a lead-in area (LIA), a data area, and a lead-out area (LOA). The data area includes a user data area assigned with physical sector numbers (PSN) and logical sector numbers (LSN), and non-user data areas having only the physical sector numbers assigned thereto.

The non-user data areas include an outer spare area (OSA) for writing data in place of a defective area of the user data area, and a Temporal Defect Lise (TDFL) area for writing navigation information pertaining to the defective areas of the user data area and to the spare area replacing the defective areas.

The data area may further include an inner spare area (ISA) at a front part of the data area in addition to or in lieu of the OSA. The TDFL area may be located at a position adjacent to the OSA in lieu of the TDFL area or in addition to the TDFL area.

Referring to FIG. 1, the VDR system of an optical disc device (20) writes data continuously on a predetermined writing sector in the user data area, where a writing sector may be set to be a Defect Verity Unit (DVU) of a certain recording size equivalent to one or more than one physical track or cluster.

After writing the data on the DVU, the VDR system (12) reproduces data written on the defective detection unit for verifying that the data was properly written on the DVU and repeats steps for detecting the defective area. For example, after writing first to fifth clusters of data (Clusters #1 ~ #5) continuously as a first defect verify unit DVU #1 (S10), the VDR system reproduces the data written on the first defect verify unit progressively and detects the defective area.

As shown in FIG. 3, if a defective area is detected in the second cluster (S11), the data written to the second cluster, which may be temporarily stored in an inner buffer of the VDR system (not shown), are written onto a cluster/replacement area within the OSA (S12).

In this instance, Cluster #2 data may be written in the OSA starting from either the rear end or the fore end of the OSA. After the replacement writing for Cluster #2 is completed, the VDR system (12) reproduces the data written on the Cluster #3 of the first defect detection unit. If a defective area is detected from the fourth cluster (S13) the VDR system (12)

carries out a replacement writing operation as discussed above to write the data written in the defective Cluster #4 area onto a next available area within the OSA, e.g., an area adjacent to the replacement area for Cluster #2 (S14).

As a result, in this example, DVU #1 ends up having Clusters #1, #3, and #5 and two defective areas and two defective areas, where the OSA are used to write data thereon in lieu of the Clusters #2and $4 using a linear replacement scheme.

Once the data recording (Recording 1) having a temporal continuity ends (which includes the data write operations, the defective area detecting operations and replacement writing operations for DVU #1, DVU #2, ..., DVU #n), the VDR system (12) writes navigation information onto the TDFL area.

In this instance, the navigation information may be managed as, e.g., TDFL. As shown in Fig. 4, the TDFL may include a plurality of defect entries (Defect_Entry #1 ~ #m). Each defect entry has a first physical sector number of a corresponding defective area (PSN of Defective), a first physical sector number of a replacement area corresponding to that defective area (PSN of Replacement), stats information (Status), and any other data pertaining to a defect entry.

As an example only, if the stats information (Status) is 'Status = 0000', this status information indicates that the navigation information written in the corresponding defect

entry is a first-time navigation information on the data written in lieu of the defective area detected at the time of data writing operation. On the other hand, if the status information is 'Status = 1001', this status information indicates that the navigation information written in the corresponding defect entry is not the first-time management information, but is a second-time management information. That is, it indicates that there was a defect in the first replacement area

As shown in FIG. 5, in the VDR system (12), in the data writing operation when the Cluster #2 is written onto a replacement area within the OSA due to a defect in the corresponding cluster area of the user data area, the VDR system (12) writes TDFL information pertaining to Cluster #2 onto the TDFL area as discussed above. This TDFL information contains a first defect entry (Defect_Entry #1) pertaining to Cluster #2, a physical sector number of the replacement area (PSN of Replacement Cluster #2), a physical sector number of the second cluster area having a defect (PSN of Defective Cluster #2), the status information of 'Status = 0000', and so on.

Thereafter, if a new defect is detected in the middle of reproduction of the second cluster of data Cluster #2 written in the replacement area of the OSA according to the data reproduction operation, the second cluster of data

Cluster #2 is written onto a second replacement area of the OSA. The physical sector number of the second replacement area (PSN of Replacement Cluster #2 (New)), the physical sector number of the second cluster area of the user data area having a defect (PSN of Defective Cluster #2), the status information of 'Status = 1001' is written onto the TDFL area as a (m+1)th defect entry (Defect_Entry #m+1).

When a data reproduction operation is carried out again, the second cluster of data written in the second replacement area of the OSA is read and reproduced based on the stored TDFL information of the (m+1)th defect entry while disregarding the TDFL information on the first defect entry written before. The status information of '1001' value included in the (m+1)th defect entry (Defect_Entry #(m+1)) indicates to the VDR system (12) to disregard the data obtained from using the previous defect entry (Defect_Entry #1).

As shown in FIG. 3, once the writing of the TDFL information for Recording 1 is completed, the VDR system (12) may continue with another data writing operation having a temporal continuity.

For fast access to the TDFL information written thus far, the VDR system (12) may be configured to write fast access information. The fast access information may be, for example, Temporary Disc Definition Structure (TDDS)

information and may be written in a reserved area of the LIA.

As shown in FIG. 4, for instance, the TDDS information includes physical sector numbers (PSN of TDFL #1) each indicating a location of a TDFL, flag information (Spare amp; TDFL Full Flag) for indicating whether or not the OSA area and/or the TDFL area is full, and any other information pertaining to the TDFL information.

If the flag information in the TDDS indicates that the OSA and the TDFL area are full with data, then the VDR system (12) does not carry out, but omits any unnecessary defective area detecting and replacement writing operations. The defective area detecting and replacement writing operations can be stopped without a command for finalizing the data writing, such as a 'Disc Finalize' command.

Upon reception of the command for finalizing the data, such as a 'Disc Finalize' command, if the flag information indicates that the OSA and the TDFL area are not full, then the VDR system (12) may keep performing the defective area detecting and replacement writing operations.

In another example, upon reception of the command for finalizing the data writing on the BD-WO, such as a 'Disc Finalize' command, in the middle of the defective area detecting and replacement writing operations, and if the flag information indicate\s that the OSA and the TDFL area are not full, then the VDR system (12) may keep performing the

defective area detecting and replacement writing operations even though the VDR system (12) stops a general data writing operation.

The VDR system (12) reads the TDDS information and the TDFL information and writes them permanently onto the Defect Management Area (DMA) in the LIA as DMA information. That is, TDMA information composed of the TDDS information and the TDFL information is transferred onto the DMA as DMA information composed of the DDS information and DFL information.

The first and second defect management areas (DMA 1, 2) may be assigned to the LIS, and third and fourth defect management areas (DMA 3, 4) may be assigned to the LOA. The DDS information and the DFL information can be stored in any one of the DMAs.

Accordingly, when the optical disc device carries out a data reproduction operation, the data written in the replacement area of the spare area, instead of the defective area of the user data area, can be read and reproduced using the DDS information and the DFL information.

Moreover, the data written in a subsequent replacement area due to any defect in the replacement areas can be read and reproduced properly using the status information in the defect entries (Defect_Entry).

Furthermore, any unnecessary defect detecting and replacement writing operations can be stopped automatically

with reference to the flag information (Spare amp; TDFL Full Flag) included in the TDDS information and the like, if the spare area and the TDFL area are full.

Referring to FIG. 6, the BD-WO is a dual layer disc having a first layer (Later 0) and a second layer (Layer 1). The TDFL area can be assigned to the LIA of the first layer and a non-user data area adjacent to the LOA of the second layer.

Also, a first outer spare area (OSA 0) and a second outer spare area (OSA 1) may be assigned to non-user data areas adjacent to the outer zone (Outer Zone 0) of the first layer and the outer zone (Outer Zone 1) of the second layer, respectively.

The TDFL area may have a recording size equivalent to 2048 physical clusters, and each OSA may have a recording size equivalent to multiple of 256 physical clusters.

As shown in FIG. 7, the TDFL information and the TDSS information can be stored in a specified recording area prior to the data area, for example, the LIA.

The VDR system (12) reads the TDDS information and the TDFL information stored in the LIA, and writes in the DMA assigned to the LIA as DDS information and DFL information.

As has been described, referring to flag information stored in the TDDS information, the VDR system stops any unnecessary defective area detecting and replacement writing

operations if the flag information indicates that the spare area is full with data.

It will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the spirit or scope of the inventions. Thus, it is intended that the present invention covers the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

[EFFECT OF THE INVENTION]

As has been described, a method for managing a defective area of a write-once type optical disc according to the present invention provides several following effects or advantages.

The method for managing a defective area of a write-once type optical disc permits reading and/or reproducing of data written on a defective area of the recording medium such as BD-WO, properly by writing the data on a spare area in lieu of the defective area and managing the temporary management data, effectively. In addition, the method and apparatus can read and reproduce the data written in other replacement areas when the first replacement area is found to be defective, using status information in a defect entry. The method and apparatus can stop unnecessary defect detecting and/or

replacement writing operations if the spare area and the TDFL area are indicated as full based on flag information stored in TDDS information.

What is claimed is :

1. A method for managing a defective area on an optical disc of writable once type including:

a first step of writing data at a predetermined area and detecting an existence of a defective area within the recording area;

a second step of writing data recorded in the defective area onto the spare area allocated in the data area;

a third step of writing navigation information for the defective area onto a specified area allocated in the data area; and

a fourth step of writing information for accessing the navigation information written on the specified area onto a reserved area in the Lead-In Area.

2. A method for managing a defective area on an optical disc of writable once type as claimed in claim 1, further including a step of writing information in a reserved area of the LIA and navigation information in a specified area of the data area into a defective management area in the LIA.

3. A method for managing a defective area on an optical disc of writable once type as claimed in claim 1, wherein the spare area is assigned as an inner spare area and an outer spare area to a fore end and a rear end of the non-user data

area having no logical sector numbers assigned thereto.

4. A method for managing a defective area on an optical disc of writable once type as claimed in claim 1, wherein the specified area is assigned as a temporal defect list area to a fore end and a rear end of the non-user data area having no logical sector numbers assigned thereto.

5. A method for managing a defective area on an optical disc of writable once type as claimed in claim 1, wherein the navigation information is temporal defect list information and stores location information of the defect area, location information of data stored in the spare area, and status information for identifying the navigation information.

6. A method for managing a defective area on an optical disc of writable once type as claimed in claim 5, wherein the status information is classified by identification value for indicating the navigation information for managing stored data when indicating navigation information newly generated and stored for managing data or performing storing general data if stored data in the spare area is stored again.

7. A method for managing a defective area on an optical disc of writable once type as claimed in claim 1, wherein the

information stored in a reserved area in the LIA is temporal disc definition structure information and writes flag information for detecting whether the specified or spare area are full with data.

8. A method for managing a defective area on an optical disc of writable once type including:

a first step of writing data recorded in the defective area onto the spare area allocated in the data area; and

a second step of writing navigation information for the defective area onto a specified area allocated in the data area, and

the location information stored data for the last is stored in the navigation information together with identification information for identifying the fact if the defect is detected from data stored in the spare area and stored into another space of the spare area.

9. A method for managing a defective area on an optical disc of writable once type as claimed in claim 8, wherein the identification information is status information for identifying that the location information of the stored data is a location information of the stored data when performing writing general data or data stored in the spare area when performing data reproduction.

10. A method for managing a defective area on an optical disc of writable once type as claimed in claim 9, wherein the status information is written as defect entries together with location information of data stored in the spare area and location information of defect area in the data area.

11. A method for managing a defective area on an optical disc of writable once type as claimed in claim 10, further including a step of reading and reproducing data stored in the spare area referring to the status information stored in the defect entries when performing the data reproduction operation after the third step.

12. A method for managing a defective area on an optical disc of writable once type including:

a first step of detecting whether or not a spare area or a specified area assigned to the data area are full with data when recording and reproducing data; and

a second step of stopping detecting defective area and recording replacement operations if the spare area or the specified area are full with data.

13. A method for managing a defective area on an optical disc of writable once type as claimed in claim 12, wherein the first step is for detecting whether the spare area

or specified area are full with data based on the flag information written in the LIA.

14. A method for managing a defective area on an optical disc of writable once type as claimed in claim 13, wherein the flag information is stored as temporal disc definition structure information in a reserved area in the LIA or in the defect management area of the LIA.

15. A method for managing a defective area on an optical disc of writable once type as claimed in claim 12, wherein the second step is for stopping defect area detection and replacement writing operation without any command for finalizing data reproduction on an optical disc if the spare area or the specified area are full with data.

16. A method for managing a defective area on an optical disc of writable once type as claimed in claim 12, further including a step of continuously performing the defective area detection and replacement writing operation if the spare area or the specified area not full with data.

17. A method for managing a defective area on an optical disc of writable once type as claimed in claim 12, further including a step of keep performing the defect area

detection and replacement writing operations and stopping a general data writing operation if a command for finalizing data writing is received in a state that the spare area or the specified area are not full with data.

18. A method for managing a defective area on an optical disc of writable once type including:

a first step of writing data at a predetermined area and detecting an existence of a defective area within the recording area;

a second step of writing data recorded in the defective area onto the spare area allocated in the data area;

a third step of writing navigation information for the defective area onto a specified area allocated in the data area; and

a fourth step of writing information for accessing the navigation information written on the specified area.

19. A method for managing a defective area on an optical disc of writable once type including:

a first step of writing data recorded in the defective area onto the spare area allocated in the data area; and

a second step of writing navigation information for the defective area onto a specified area allocated in prior to the data area, and

the location information stored data for the last is stored in the navigation information together with identification information for identifying the fact if the defect is detected from data stored in the spare area and stored into another space of the spare area.

20. In an optical disc of writable once type in which lead-in area and data area are assigned, an optical disc of writable once type assigning a spare area for writing data of defective area in the data area, and the navigation information of the defective area is stored in prior to the data area as a temporary defect list.

21. An optical disc of writable once type as claimed in claim 20, wherein the temporal defect list is stored in the LIA together with final defect list.

22. In an optical disc of writable once type in which lead-in area and data area are assigned, an optical disc of writable once type assigning a spare area for writing data of defective area in the data area, and the navigation information of the defective area is stored in the data area as a temporary defect list.

23. An optical disc of writable once type as claimed in

claim 22, wherein the final defect list is stored in the LIA.